APRIL 9.

Mr. GEORGE W. TRYON, Jr., in the chair.

Twenty-two persons present.

The following papers were presented for publication:—

"Transition forms in Crinoids, and description of five new species," by Charles Wachsmuth and Frank Springer.

"On a new Species of Sponge," by Alpheus Hyatt.

Vegetative Repetition of Cerebral Fissures.—Dr. A. J. PARKER remarked that in studying the cerebral fissures, as found in the brains of different animals, we find them divided into several groups. These are called primary, secondary, tertiary, etc., according to their constancy and degree of importance. The primary fissures comprise those fundamental, deep, and important clefts, which appear earliest in the development of the embryo, and are to be found represented in all brains where marked fissuration exists. They correspond in position and bear definite relations with deep and important structures. The secondary fissures come next in importance. They appear in the embryo after the primary, and comprise those fissures which give the general character of fissuration to groups of brains. Tertiary fissures, etc., are the smaller, less important ones which branch off from the primary and secondary, or mark more or less deeply the various separate convolutions formed by the other fissures. These fissures give the special character to each brain, and enable us to point it out as belonging to this or that genus or species of animals. The constancy in appearance and position of these fissures follows the same order as given above; that is, the primary are the most constant in appearance and position, the secondary next, whilst the tertiary, etc., are the most variable; many of the minor branches of this latter group being present or absent, even in the same species of animal. With reference to the cause of development of these fissures three views are held.

According to one view, which is the one that has had most currency until within recent years, and which is still supported by many, such as Ecker, etc., the fissures of the cerebral cortex are due to mechanical causes entirely, being produced by the cranial contents developing more rapidly than the cavity of the skull, the brain folding itself in order to accommodate itself in bulk to the space allowed by its rigid bony environment. In this case, therefore, the fissures represent merely lines of least resistance to the compressing forces, and have no structural significance. According to the second view, fissures represent lines of retarded

growth; that is, along these lines of the cerebral cortex, growth takes place less rapidly than in the surrounding portion, and these lines are, therefore, gradually converted into deep grooves or fissures. The third view is a compound of the other two. According to this, the principal fissures are produced by retarded growth, whilst many of the undulations and minor furrows are produced by compression.

Whichever view we adopt, the question still presents itself, are we to regard each fissure as produced by a distinct and separate process of formation, or are some of them only repetitions of fissures previously formed? In studying the cerebral fissures as presented in the brains of different animals, especially amongst the Carnivora and Ungulata, it had appeared to him that many of the fissures should be regarded in the latter light, that is, as vegetative repetitions. Viewed in this way, many difficulties with regard to the identification of homologous fissures in different brains disappear. According to the mechanical theory, a deep and distinct fissure having been formed, there would be a tendency to produce other fissures following the same general direction, having the same general appearance, and depending for their formation on the one originally laid down. According to the view that fissures are the result of retarded cerebral growth, we may expect to find, especially in lower forms of brains in which much fissuration exists, vegetative repetitions of the same lines of retarded growth. In either case, the fissures which appear after the original fissure, and which follow its general contour, should be considered as belonging to one group with that fissure, and to be of secondary importance in relation to it. Hence, in many cases, instead of seeking for fissures separately homologous to each other, we will be obliged to consider certain groups to be homologous to certain other groups, the number of separate fissures of which may be more or less numerous. Owen, in founding his nomenclature of the cerebral fissures in the Carnivora and Ungulata, gave a distinct and separate name to each fissure, and he endeavored to point out the homologue of each of these in different brains. If, however, we are to regard, as he should presently attempt to show, that at least some of these fissures are entirely secondary and to be considered as merely vegetative repetitions, then we must not seek, nor is it possible to find, homologues for each fissure, even in closely related brains.

Dr. Parker then proceeded to point out some of the fissures in the brain of the Carnivora and Ungulata, which appeared to him to be of the above nature.

If we take the brain of a carnivorous animal, as the domestic cat for instance, and examine the upper mesial surface of one of the hemispheres, we will find three fissures lying nearly parallel to each other, one above the other and proceeding postero-anteriorly. The upper two of these extend from the posterior extremity of the

hemisphere, whilst the lower one begins a little anterior to the middle. It is the anterior extremity of this fissure which extends in a transverse direction on to the lateral surface of the hemisphere, and is known under the name of the crucial fissure. The whole fissure is called frontal by Owen. The middle fissure he terms the super-callosal, and the upper, the marginal fissure. This represents the state of things very nearly as found in the brains of all of the Carnivora. In some cases, however, he had found only two fissures instead of three, the frontal being continuous with the super-callosal; there being, however, a decided indication of a tendency towards separation at the anterior portion of this fissure. Thus in two specimens of *Coati nasica*, the frontal fissure was a branch of the super-callosal, a notch, however, indicating where the proper super-callosal would end. In two specimens of the brain of the lion, the frontal fissure was barely separated from the super-callosal, and in examining other brains of Carnivora intermediate stages were met with, from the condition as in *Coati nasica* where the two fissures were continuous to the state as found in the cat and ocelot where they are widely separated. It would appear, therefore, that the frontal fissure is of the nature of a separated anterior extremity of the super-callosal; and as such he had regarded it, considering it as a repetition of that fissure. The marginal fissure lies directly above the super-callosal, is similar in appearance and follows the same direction, but is not as deep or well marked, and appears in the embryo after it. This fissure should also, he thought, be considered in a secondary light to the super-callosal and to be a repetition of it. In some of the carnivora, as in the specimens of the brain of the lion, a fourth fissure makes its appearance in this region; lying between the super-callosal and marginal fissures, and similar in appearance and relations to them. He had, therefore, considered all of these fissures as belonging to one group, of which the super-callosal is the type, and the remaining fissures more or less numerous as vegetative repetitions of this fundamental and typical furrow. In a paper on the morphology of the cerebral convolutions, not yet published, he had called this fissure the mesial occipito-frontal, from its arising in the occipital region and proceeding forwards into the frontal lobe; whilst the remaining furrows he proposed to call the first, second, third, etc., repetitions of this fissure, designating the typical fissure by the letters *mof*, and its repetitions by *mof′*, *mof″*, *mof‴*, etc., respectively. The bearing of this will be rendered more evident, if we now compare these fissures as found in the Carnivora with the same as found in the Ungulata. In the Ungulata a fissure is found on the mesial surface of the hemisphere which is the homologue of the mesial occipito-frontal of the Carnivora. It takes its origin in the posterior or occipital region and proceeds forwards into the frontal lobe. Besides this, there are one or two other fissures present lying

parallel with it which may be considered as repetitions of it. In these brains, however, the marginal fissure, which in the Carnivora lies on the mesial surface, appears on the lateral surface of the brain, together with a number of fissures more or less numerous, similar to it, and which are not represented in the brain of the Carnivora. It is this collection of fissures that gives to this region of the brain the complex character, and extensive fissuration which it presents. The brain of the Peccary, *Dicotyles torquatus*, seems to occupy a position in reference to these fissures, midway between the brain of the Carnivora and the brains of the other Ungulata. In the brain of this animal, we find on the mesial surface a distinct and well marked mesial occipito-frontal fissure, extending from the occipital region forwards and encircling the corpus callosum just as the fissura calloso-marginalis does in man, of which it is the homologue. A short distance posterior to its central point, a small fissure forks off from it, still remaining continuous with it. No other fissures are found on the mesial surface proper, but at the edge of the hemisphere, where the lateral and mesial surfaces join, a distinct and well marked fissure is found which follows the direction of the mesial occipito-frontal fissure and corresponds to the marginal fissure of the Carnivora; which he had regarded as a repetition of the mesial fissure, and designated as *mof'*. On the lateral surface in this brain there are no other fissures which can be considered as repetitions, but as we advance through a series of ungulate brains, this tendency to repetition in this region becomes exceedingly marked, and so numerous that they cover a considerable portion of the lateral surface of the brain. In *Dicotyles*, as we have seen, there is only a single fissure present, but these gradually increase in number until in some brains as many as five can be distinguished. In the Caribou and Sheep, two may be seen. In the Giraffe, Malay Tapir, and Llama, etc., three may be distinguished, and in the Horse he had counted as many as five. It is to this repetition of the same fissure that the exceedingly convoluted appearance of this portion of the ungulate brain is due, and not to the production of fissures which are to be considered as of the same importance as the other fissures of the hemispheres. Thus, although the brains of the Ungulata are much more convoluted than the brains of any of the Primates, except man and a few of the higher apes, still they must be regarded as of a lower type, since this more highly convoluted aspect is produced, not by a greater number of distinctive fissures, but to a great extent by simple vegetative repetition of fissures, which are found represented in these primate brains by a single furrow. Thus, the five fissures as found in the Horse, taken together are equivalent to the three as found in the Tapir, Giraffe, Llama, etc., to the two in the Sheep and Caribou, to the single fissure as found in *Dicotyles*; and finally they are all to be considered as vegetative repetitions of the mesial occipito-

frontal fissure. In the Primates, this fissure is represented by the fissure calloso-marginalis, and here the same tendency is also shown, as we ascend from the lower groups towards Man, to split up into two or more similar fissures. Among the *Lemuridæ*, as *Propithecus*, *Indris*, *Avalis*, *etc.;* in the *Platyrrhini*, as *Hapale*, *Chrysothrix*, *Ateles*, *Cebus*, *etc.;* and in the *Cynomorpha*, as *Macacus*, *Cynocephalus*, *etc.;* this fissure is represented by a single continuous furrow. In the *Anthropomorpha*, as the Chimpanzee and Orang, this fissure becomes much broken in its character; and in Man it consists of several distinct parts, which are similar in appearance and relations to each other. He had noticed in some brains as many as five or six of these separate and distinct fissures following each other regularly along the course of the calloso-marginal fissure. They tend in appearance towards the shape of an elongated figure four. He had observed that this repetition is especially regular, and well marked in the brain of the negro. The calloso-marginal fissure is described as terminating posteriorly a short distance behind the central fissure, appearing as a slight notch on the lateral surface of the hemisphere. Directly back of this, a small fissure is present, situated on the præcuneal lobule, which has been regarded as a distinct and unimportant fissure merely marking this lobule. From a study of a number of brains, he had been led to consider this as the posterior portion of the calloso-marginal fissure detached from it, just as the anterior portion splits up into several parts. In the Orang and Chimpanzee this also appears to be detached, but in the lower forms the calloso-marginal fissure extends back without any break in its continuity. In the human embryo the calloso-marginal at the sixth month is represented by a continuous fissure, and it is only in the latter stages of development that it breaks up into separate parts. The fissures of the occipital lobe in those Primates in which it is fissured, appear also to be repetitions of pre-existing fissures. In the lower forms of the *Simiadæ*, the occipital lobe appears perfectly smooth and without any fissuration whatever. It is separated from the rest of the hemisphere by two well marked fissures. These arch, the one above and the other below the posterior extremity of the calcarine fissure on the mesial surface, and extending over on to the lateral surface run towards each other, and are separated only by a small narrow convolution, the *troisieme pli de passage externe* of Gratiolet. The two fissures together form an arch, which cuts off, on the posterior lateral surface of the hemisphere, a conical-shaped mass, the apex of which is directed forwards and downwards. These two fissures taken together he would term the primary occipital arch, and it constitutes the anterior boundary of the occipital lobe. This lobe is entirely smooth in many of the lower forms of the *Simiadæ*. Thus, in *Macacus cynomolgus* no fissures are present, but, as we ascend, this lobe becomes gradually more and more

fissured. These fissures, when they appear, follow the direction of the primary occipital arch, so that a secondary arch appears within the first. This arch, in the same manner as the primary, extends around the upper and lower branches of the posterior extremity of the calcarine fissure. It might be well seen in many of the photographs to which he directed attention, especially in *Macacus nemestrinus* and in *Cynocephalus pors*. Sometimes this secondary arch is interrupted at one or two places by small convolutions, just as the primary arch is by the various *plis de passage*, but the separate portions still preserve the same relations as before. In the higher Apes these arches become more undulated. This is also the case in *Ateles*. In Man they become very much contorted and broken up, and it becomes difficult to recognize the relations between these detached portions and the parts of the primary arch which also become much separated. In the negro, these fissures remain more nearly in the state in which they are found in the higher Simians, and the correspondence between the two arches can be more clearly distinguished. The fissures of the occipital lobe should not, it appeared to him, be considered as of the same significance as the fissures of the other lobes, or as the fissures of the primary arch, but of secondary importance, and he would regard them as repetitions of the two branches of this arch.

In the temporal lobe Ecker has described a fourth temporal fissure in addition to the three usually recognized. This fissure is, however, as he admits, but slightly developed and often absent. He would regard this fissure in the same light as the fissure of the occipital lobe, viz., as a repetition of one of the temporal fissures. These constitute the most important fissures which he had been led to consider as of secondary significance, since they merely follow lines of development already laid down by a preceding furrow, and do not partake of the nature of independent fissures to the same extent as many others, although they may appear by their length and depth to be of equal morphological significance.

The following papers were ordered to be printed:—